WHAT IS CLAIMED IS:

1. An approximate calculator for calculating an approximate value of a non-linear function using input data, comprising:

decoder means for outputting m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line and outputting intercept data of said coordinate straight line based on said input data, said coordinate straight line interpolating said non-linear function for an interval that includes a value of said input data as one value of one of coordinates and having a slope of 2^n (n is an integer), said intercept data representing intercept of said coordinate straight line;

shifter means for shifting said input data by $|n|$ bits based on said m-bit data and outputting resultant data as first term data; and

approximation output means for generating and outputting said approximate value of said non-linear function based on said first term data and said intercept data.

2. An approximate calculator for calculating an approximate value y of a non-linear function $Y = \log(1 + e^{-X})$ using input data x, comprising:

decoder means for outputting m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line and outputting intercept data of said coordinate straight line based on said input data x, said coordinate straight

line interpolating said nonlinear function $Y = \log(1 + e^{-X})$ for an interval that includes a value of said input data x as an X-value and having a slope of 2^n (n is an integer), said intercept data representing Y-intercept of said coordinate straight line;

shifter means for shifting said input data by $|n|$ bits based on said m-bit data and outputting resultant data as first term data; and

approximation output means for generating and outputting said approximate value y of said non-linear function $Y = \log(1 + e^{-X})$ based on said first term data and said intercept data.

3. An approximate calculator for calculating an approximate value of a non-linear function $\log(e^a + e^b)$ using input data a and b, comprising:

selector means for selecting larger one max (a, b) from said input data a and b;

decoder means for outputting m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line and outputting intercept data of said coordinate straight line based on an absolute value $|a-b|$ of difference $(a-b)$ of said input data a and b, said coordinate straight line interpolating a non-linear function $Y = \log(1 + e^{-X})$ for an interval that includes said absolute value $|a-b|$ as an X-value and having a slope of 2^n (n is an integer), said intercept data representing Y-intercept of said coordinate straight line;

shifter means for shifting said absolute value $|a-b|$ by $|n|$ bits based on said m-bit data and outputting resultant data as first term data of an approximate value of a non-linear function $\log(1 + e^{-|a-b|})$;

approximation output means for generating and outputting said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ based on said first term data and said intercept data; and

adder means for generating sum of a value of said larger one max (a, b) of said input data a and b and said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ and outputting the generated sum as said approximate value of said non-linear function $\log(e^a + e^b)$.

4. An approximate calculator as in claim 3, further comprising:

subtracter means for generating and outputting said difference (a-b) of said input data a and b,

wherein said selector means receives said difference (a-b) from said subtracter, and uses said received difference (a-b) for selecting said larger one max(a, b) of said input data a and b,

wherein said decoder means receives said difference (a-b) from said subtracter, and derives said absolute value $|a-b|$ from said received difference (a-b), and

wherein said shifter means receives said difference (a-b) from said subtracter, and derives said absolute value $|a-b|$ from said received difference (a-b).

5. A MAP decoder for performing MAP decoding utilizing log-BCJR algorithm, comprising:

selector means for receiving input data a and b and selecting larger one max (a, b) from said input data a and b;

decoder means for outputting m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line and outputting intercept data of said coordinate straight line based on an absolute value $|a-b|$ of difference (a-b) of said input data a and b, said coordinate straight line interpolating a non-linear function $Y = \log(1 + e^{-X})$ for an interval that includes said absolute value $|a-b|$ as an X-value and having a slope of 2^n (n is an integer), said intercept data representing Y-intercept of said coordinate straight line;

shifter means for shifting said absolute value $|a-b|$ by $|n|$ bits based on said m-bit data and outputting resultant data as first term data of an approximate value of a non-linear function $\log(1 + e^{-|a-b|})$;

approximation output means for generating and outputting said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ based on said first term data and said intercept data; and

adder means for generating sum of a value of said larger one max (a, b) of said input data a and b and said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ and outputting the

generated sum as an approximate value of said non-linear function $\log(e^a + e^b)$,

wherein said approximate value of said non-linear function $\log(e^a + e^b)$ is used for calculating state probability by forward iterations and for calculating state probability by backward iterations.

6. A MAP decoder as in claim 5, further comprising:

subtracter means for generating and outputting said difference (a-b) of said input data a and b,

wherein said selector means receives said difference (a-b) from said subtracter, and uses said received difference (a-b) for selecting said larger one max(a, b) of said input data a and b,

wherein said decoder means receives said difference (a-b) from said subtracter, and drives said absolute value $|a-b|$ from said received difference (a-b), and

wherein said shifter means receives said difference (a-b) from said subtracter, and drives said absolute value $|a-b|$ from said received difference (a-b).

7. A method for calculating an approximate value of a non-linear function using input data, comprising the steps of:

retrieving m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line based on said input data, said coordinate straight line interpolating

said non-linear function for an interval that includes a value of said input data and having a slope of 2^n (n is an integer);

retrieving intercept data of said coordinate straight line based on said input data, said intercept data representing Y-intercept of said coordinate straight line;

shifting said input data by $|n|$ bits based on said m-bit data and providing resultant data as first term data; and

generating said approximate value of said non-linear function based on said first term data and said intercept data.

8. A method for calculating an approximate value of a non-linear function $Y = \log (1 + e^{-x})$ using input data x, comprising the steps of:

retrieving m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line based on said input data x, said coordinate straight line interpolating said non-linear function $Y = \log (1 + e^{-x})$ for an interval that includes a value of said input data x as an X-value and having a slope of 2^n (n is an integer);

retrieving intercept data of said coordinate straight line based on said input data x, said intercept data representing Y-intercept of said coordinate straight line;

shifting said input data by $|n|$ bits based on said m-bit data and providing resultant data as first term data; and

generating said approximate value of said non-linear function $Y = \log(1 + e^{-X})$ based on said first term data and said intercept data.

9. A method for calculating an approximate value of a non-linear function $\log(e^a + e^b)$ using input data a and b, comprising the steps of:

selecting larger one max (a, b) from said input data a and b;

retrieving m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line based on an absolute value $|a-b|$ of difference (a-b) of said input data a and b, said coordinate straight line interpolating a non-linear function $Y = \log(1 + e^{-X})$ for an interval that includes said absolute value $|a-b|$ as an X-value and having a slope of 2^n (n is an integer);

retrieving intercept data of said coordinate straight line based on said absolute value $|a-b|$ of said difference (a-b) of said input data a and b, said intercept data representing Y-intercept of said coordinate straight line;

shifting said absolute value $|a-b|$ by $|n|$ bits based on said m-bit data and providing resultant data as first term data of an approximate value of a non-linear function $\log(1 + e^{-|a-b|})$;

generating said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ based on said first term data and said intercept data; and

generating sum of a value of said larger one max (a, b) of said input data a and b and said approximate value of said non-linear function log $(1 + e^{-|a-b|})$ and providing the generated sum as said approximate value of said non-linear function log $(e^a + e^b)$.

10. A method for performing MAP decoding utilizing log-BCJR algorithm, comprising the steps of:

receiving input data a and b;

selecting larger one max (a, b) from said input data a and b;

retrieving m-bit data (m is a natural number) that represents a value corresponding to a slope of a coordinate straight line based on an absolute value |a-b| of difference (a-b) of said input data a and b, said coordinate straight line interpolating a non-linear function $Y = \log(1 + e^{-X})$ for an interval that includes said absolute value |a-b| as an X-value and having a slope of 2^n (n is an integer);

retrieving intercept data of said coordinate straight line based on said absolute value |a-b| of said difference (a-b) of said input data a and b, said intercept data representing Y-intercept of said coordinate straight line;

shifting said absolute value |a-b| by |n| bits based on said m-bit data and providing resultant data as first term data of an approximate value of said non-linear function log $(1 + e^{-|a-b|})$;

generating said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ based on said first term data and said intercept data; and

generating sum of a value of said larger one $\max(a, b)$ of said input data a and b and said approximate value of said non-linear function $\log(1 + e^{-|a-b|})$ and providing the generated sum as an approximate value of a non-linear function $\log(e^a + e^b)$,

wherein said approximate value of said non-linear function $\log(e^a + e^b)$ is used for calculating state probability by forward iterations and for calculating state probability by backward iterations.